

THE EFFECT OF HUMIDITY AND OTHER FACTORS
ON THE UPPER THERMAL DEATH POINTS OF THE
CHINCH BUG, *BLISSUS LEUCOPTERUS* (SAY)

BY

FRANK EDWIN GUTHRIE

B.S., University of Kentucky, 1946

M.S., University of Illinois, 1949

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENTOMOLOGY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1952

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INTRODUCTION

The seemingly unending maze of literature published on investigations concerned with the effects of temperature and/or humidity on various aspects of the biologies of animals proves conclusively that this field of research is far from virgin territory. However, in any field of investigation as broad as the one with which we are concerned, many avenues of approach must necessarily be overlooked or only partially solved.

There exists a need for more thorough investigations of the effect of temperature and humidity on the life processes of small insects, especially those with piercing-sucking mouthparts. Certain basic physiological-ecological questions which have been investigated on larger insects remain unanswered among smaller insects. The most suitable biological material available for testing was the chinch bug, *Blissus leucopterus* (Say), a major insect pest in Illinois, the ecology of which was admirably adapted to this investigation.

It is the purpose of this thesis to report some new physiological-ecological observations pertaining to small insects, especially bugs. The main points which are reported in this dissertation are: (1) the discovery of the effect of relative humidity on the upper thermal death points of small insects; (2) the determination of the effect of feeding piercing-sucking insects while exposed to high lethal temperatures; (3) the investigation of the cooling effect provided by succulent food offered to sucking insects during exposure to high temperatures; and (4) the determination of the upper thermal death points of chinch bugs, thereby completing an existing gap of the ecological facts known about the chinch bug.

SUMMARY

1. The upper thermal death points of adult chinch bugs at eight different temperatures and five separate relative humidities were determined.

2. There is a point in the thermal death pattern where relative humidity has no effect on mortality, i.e. where the percent mortality is the same regardless of the relative humidity.

3. Chinch bugs are knocked down more quickly at the higher humidities, which would indicate less ability to cool themselves at the high humidities.

4. There is a reversal of the effect of relative humidity as the temperature increases. The lower the humidity below 50° C., the higher the mortality and the lower the humidity above 50° C. the lower the mortality.

5. Chinch bugs provided with succulent food during exposure to high lethal temperatures are able to increase their longevity by a factor of twenty five at the lowest humidity and a factor of two at the highest humidity.

6. Death occurs when the chinch bug loses about thirty five percent of its body moisture.

7. Desiccation becomes increasingly less effective as the cause of death as the humidity and the temperature increase.

8. At 48.8° C. and above factors other than desiccation become the primary cause of death.

9. The ability of chinch bugs to cool themselves when supplied with succulent food was briefly studied but results were disappointing and need to be more fully investigated.

10. The adult chinch bug is about fifty eight percent water.

VITA

Frank Edwin Guthrie was born January 14, 1923, in Louisville, Kentucky. He obtained his grammar school education in the public school system of Jefferson County, Kentucky. He was graduated from Louisville Male High School in 1941 and was enrolled in the University of Kentucky until 1943, at which time he entered the U. S. Marine Corps. He was commissioned a second lieutenant in the Marine Corps in 1945, served for one year in the Pacific Area with the occupational forces, and was honorably discharged in 1946 after having served forty-one months on active duty. Returning to the University of Kentucky in 1946, he served as a laboratory assistant in the zoology department for one year, and was also employed part-time by the department of entomology. In 1947, he was graduated with a B.S. degree in agriculture and immediately enrolled at the University of Illinois where he obtained his M.S. degree in entomology in 1949. He was employed as a research assistant on the Koppers Company insecticide fellowship for two and one-half years and was a field assistant at the Illinois Natural History Survey for one year. He married Bernice Button in 1947 and they have one child. He was recalled in the U. S. Marine Corps in 1951.

He is a member of the American Association of Economic Entomologists.

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